

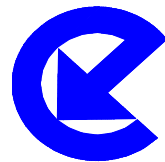
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Micro Level Data Analysis in Continuous Commissioning[®] : A Case Study

Presented by:

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Presentation Overview

- ***Brief Introduction to Continuous Commissioning®***
- ***Case Study- Anderson High School***
 - ***Facility Description***
 - ***CC® Measures***
 - ***Examples - Measures Implemented and Feedback***
 - ***Lessons***
 - ***Discussion and/or Questions***

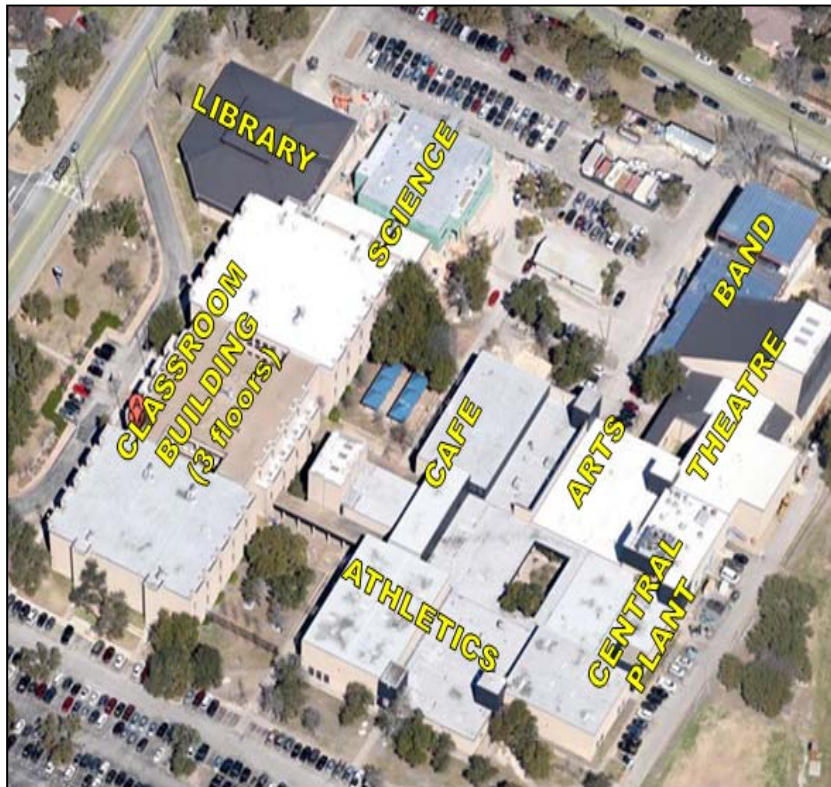
Continuous Commissioning®

- Continuous Commissioning® (CC®)
 - Suitable for complex HVAC systems
 - Applied to existing buildings
 - Quick payback (1 – 4 years)
 - ***Prime objective is the optimization of HVAC & Control systems to meet current operating conditions and improving comfort***
 - Steps - Conducting system measurements, developing a CC® plan, implementing CC® measures, and documenting energy savings and comfort improvements
 - Requires field testing and analysis
 - Compliance with ASHRAE standards
 - Requires controls sequence modifications
 - Requires performance measurements

Case Study – Anderson High School

- Anderson High School – Austin Independent School District, Austin, Texas
 - 265,180 Square Feet
 - Built in 1973 with multiple renovations and new addition in 2009
 - One main central plant and satellite plants (chilled & hot water)
 - Controls System (I/NET 7)
 - 37 DX units, 33 chilled & hot water units
 - Most classroom areas at Anderson are served by variable volume Multizone (MZ) Air-Handling Units (AHUs). Single Zone (SZ) variable volume AHUs serve large areas such as the cafeteria and gymnasium. Band and science hall are primarily served by Single Duct Variable Air Volume (SDVAV) units with terminal hot water reheat.

Facility Aerial View



Anderson High School - CC[®]

- CC[®] was recently performed at Anderson High School in Austin, Texas by Texas Energy Engineering Services, Inc. (TEESI). ESL provided whole building M&V services following project conclusion.
- Throughout the project, TEESI engineers used the closed-loop approach and BAS trend data to successfully improve the process efficiency and ultimately the end product.

Summary of CC[®] Measures Implemented

- Optimized occupancy and operation schedules
- Optimized space temperature setpoints
- Optimized Air Handling Unit fan speed and supply temperature resets
- Implemented chiller and boiler plant pump differential pressure resets
- Disabled chiller plant and hot water pump operation during unoccupied periods
- Installed VFDs on hot water distribution pumps
- Identified malfunctioning control devices and faulty sensors
 - Minor upgrades and repairs

CC[®] - Closing the Process Loop

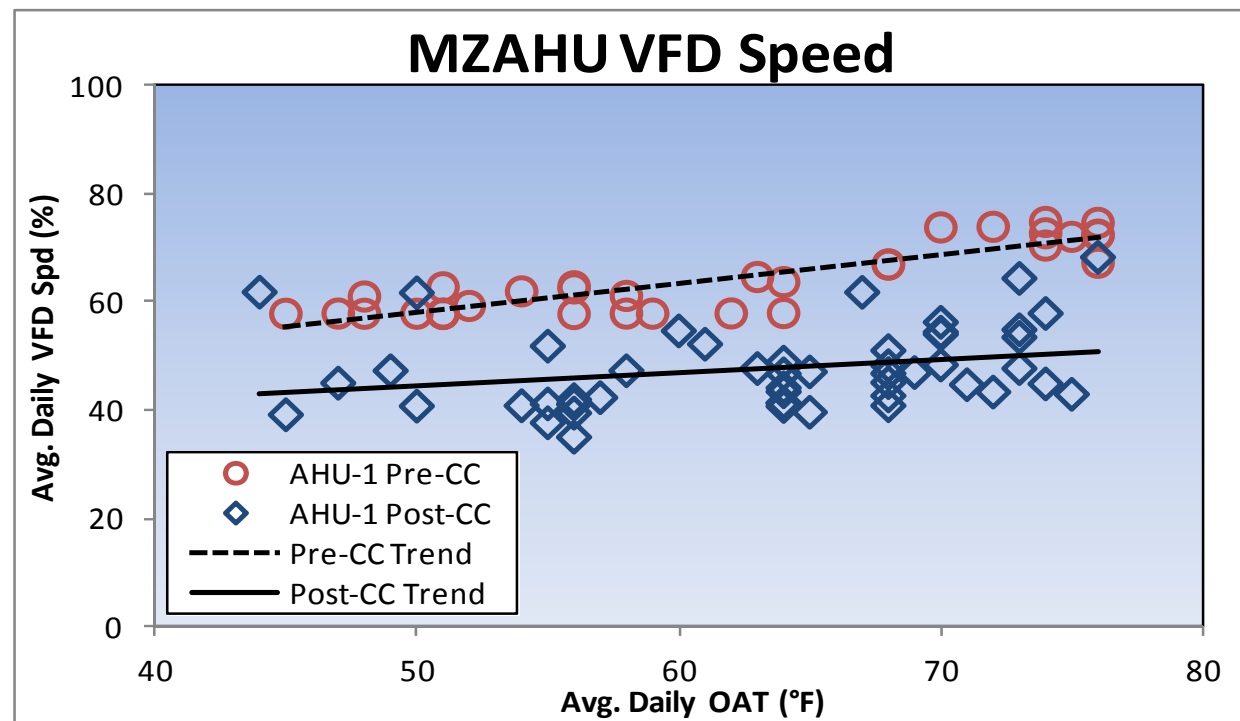
- The primary "output" of the CC[®] process used to measure its success is energy savings without sacrificing comfort
- The least expensive method of CC[®] project savings measurement is using building utility data gathered over several months before and after implementation (IPMVP-Option C)
 - May take up to 12 months “Open loop”
 - Fail to demonstrate the success or failure of individual measures
- Using trend data within the Building Automation System (BAS) can be a cost effective way to improve the frequency and resolution of this feedback and close the process loop

Closing the CC[®] Process Loop

- Important factors for consideration
 - Study and evaluation of existing control schemes
 - Knowledge of control system
 - Identify “heavy hitting” measures for trend setup
 - Data routing and storage
 - Time constraints
 - Network traffic
 - Data normalization, filtering and analysis
 - Conduct trail and share findings with facility maintenance and/or occupants
 - Improve measure with resulting feedback

Example(s) - Measures Implemented and Feedback

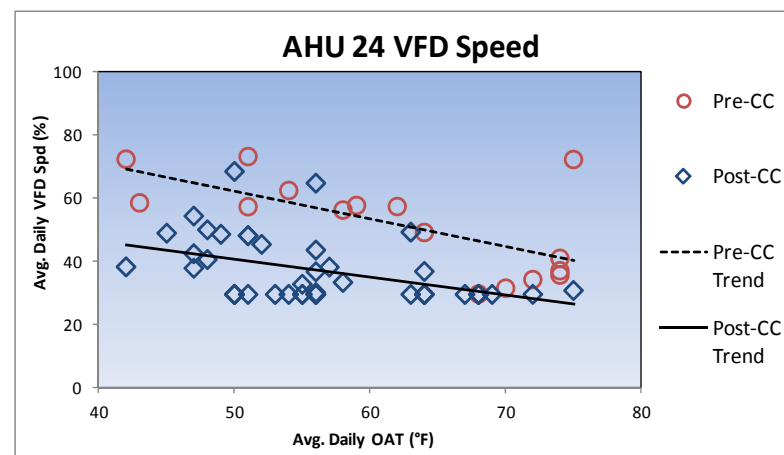
- Multizone Air handling Units.
 - Cooling/Heating demand based reset compared to existing reset based on outside air temperature.



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Examples (cont.)

- Single Zone Air handling Units.
 - The existing SZ AHU sequences at Anderson were already using a demand based reset of SAT and fan speed, but not to optimal capacity.
 - The sequence was modified to split the sensor signal and respond to cooling or heating demand with warmer or colder air, respectively, first before ramping up fan speed. The fan speed was allowed to modulate from its minimum setting only once SAT reached its lower or upper limit.

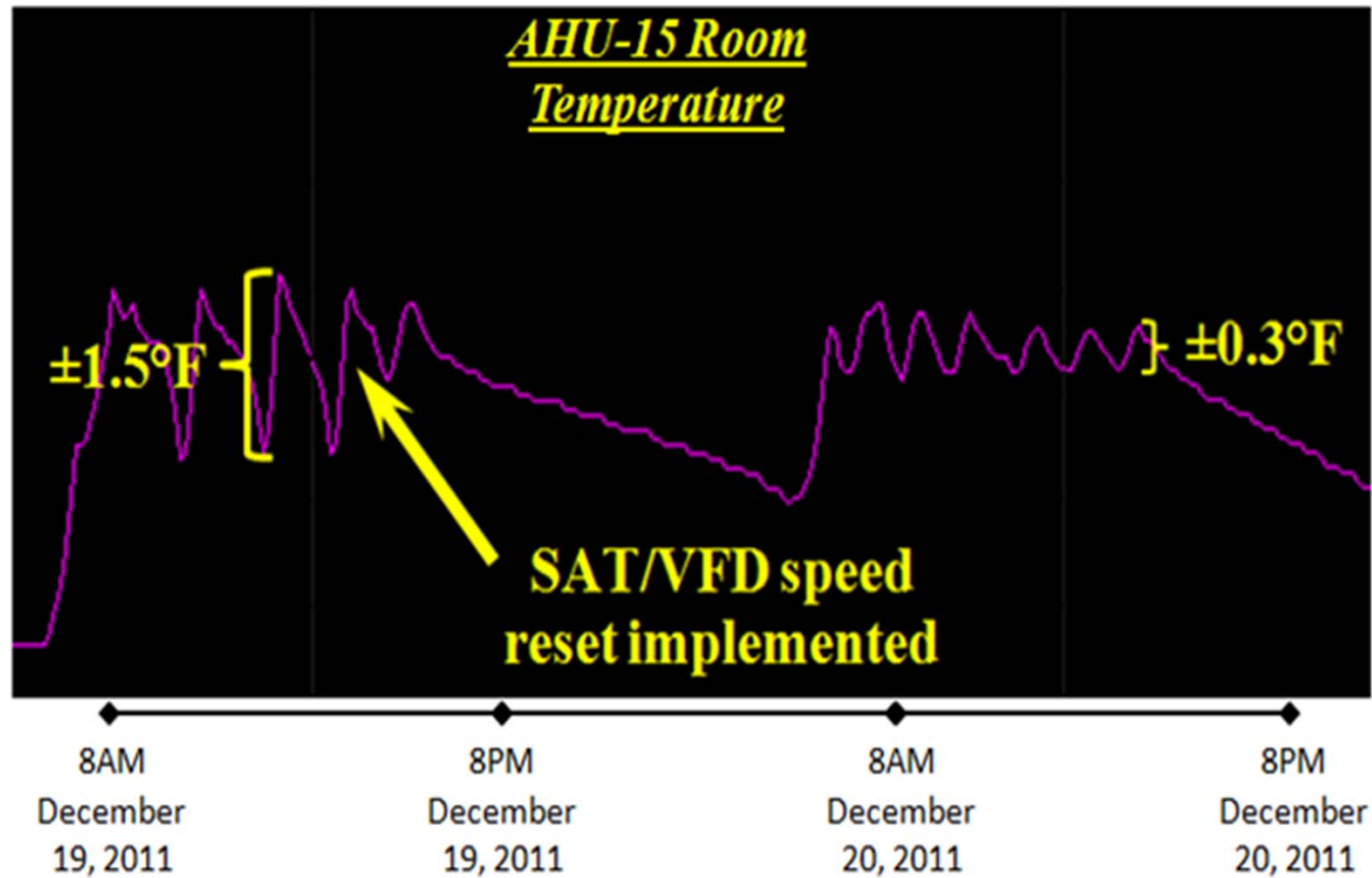


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Examples (cont.)

- Single Zone Air handling Units.
 - The existing simultaneous control of supply temperature and flow also caused the units to overreact to space cooling or heating demand and overshoot the setpoint. This resulted in large, potentially uncomfortable temperature oscillations in the space.
 - The oscillatory behavior was identified from time series trend data directly within the BAS and remedied immediately with the new sequence. Splitting the thermostat signal had the secondary effect of softening the AHU response to space temperature, thus tuning and tightening the control.

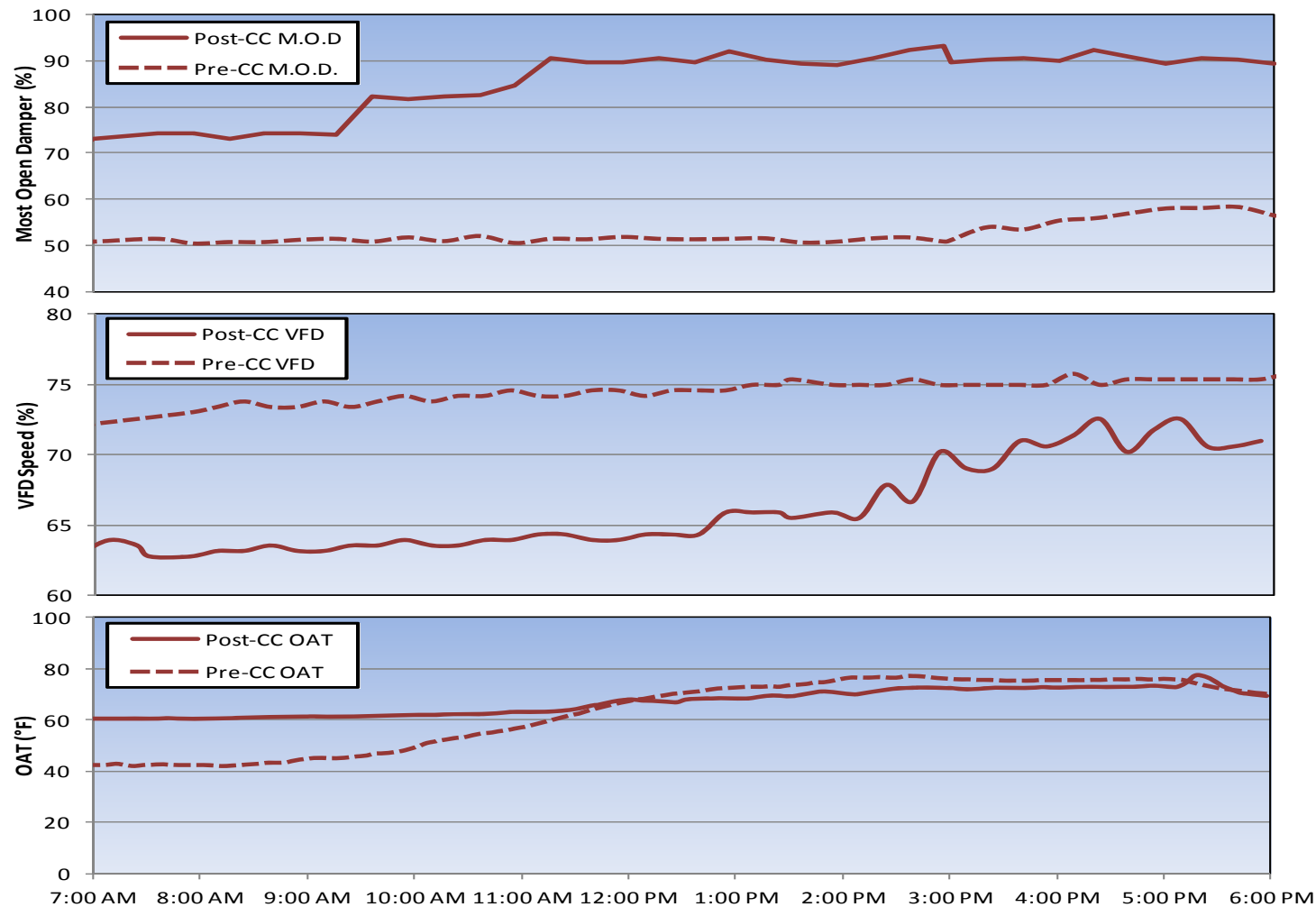
Examples (cont.)



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Examples (cont.)

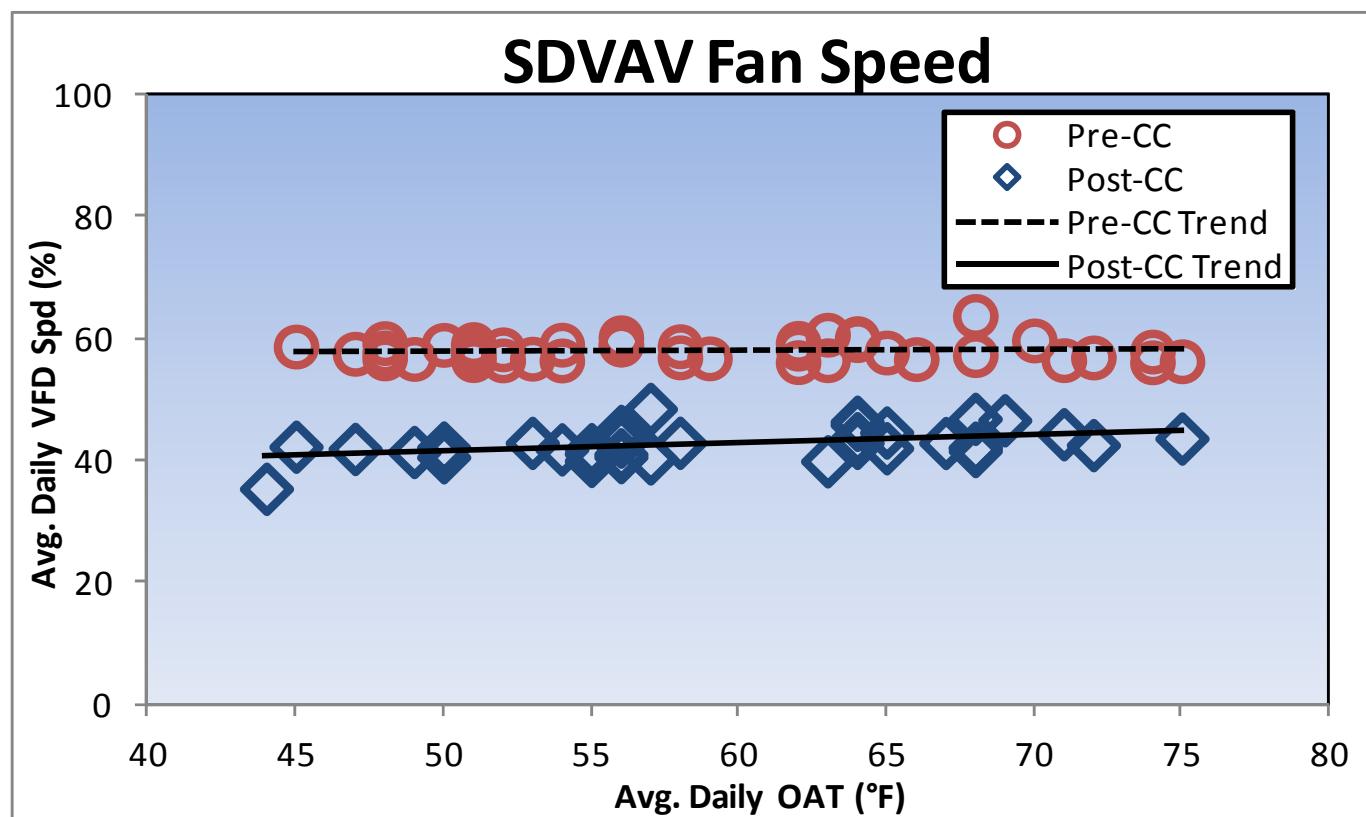
- SDVAV units reset static pressure to maintain most open terminal unit damper at 90%, rather than keeping it constant.



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Examples (cont.)

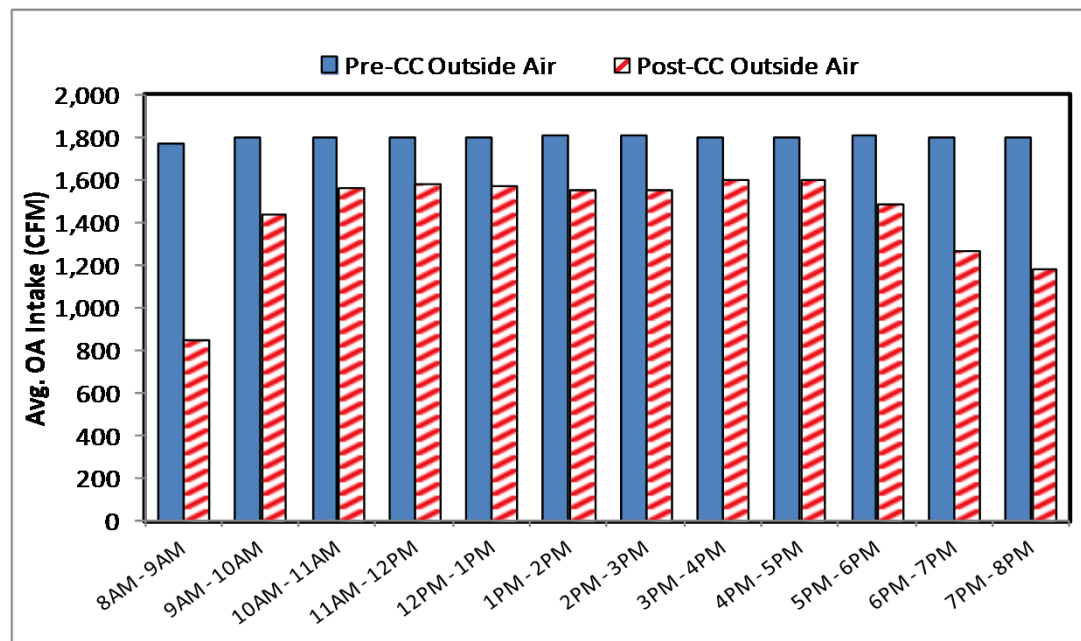
- SDVAV units reset static pressure.



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Examples (cont.)

- SDVAV-served spaces at Anderson HS are equipped with motion sensors whose signals are tied into the BAS. The system was previously using these signals to set back or set up the space temperature setpoint when no occupancy was sensed. Building on this, and extending the concept of demand based resets, the CC[®] team implemented a reset of the outside air volume setpoint based on the number of occupied zones.

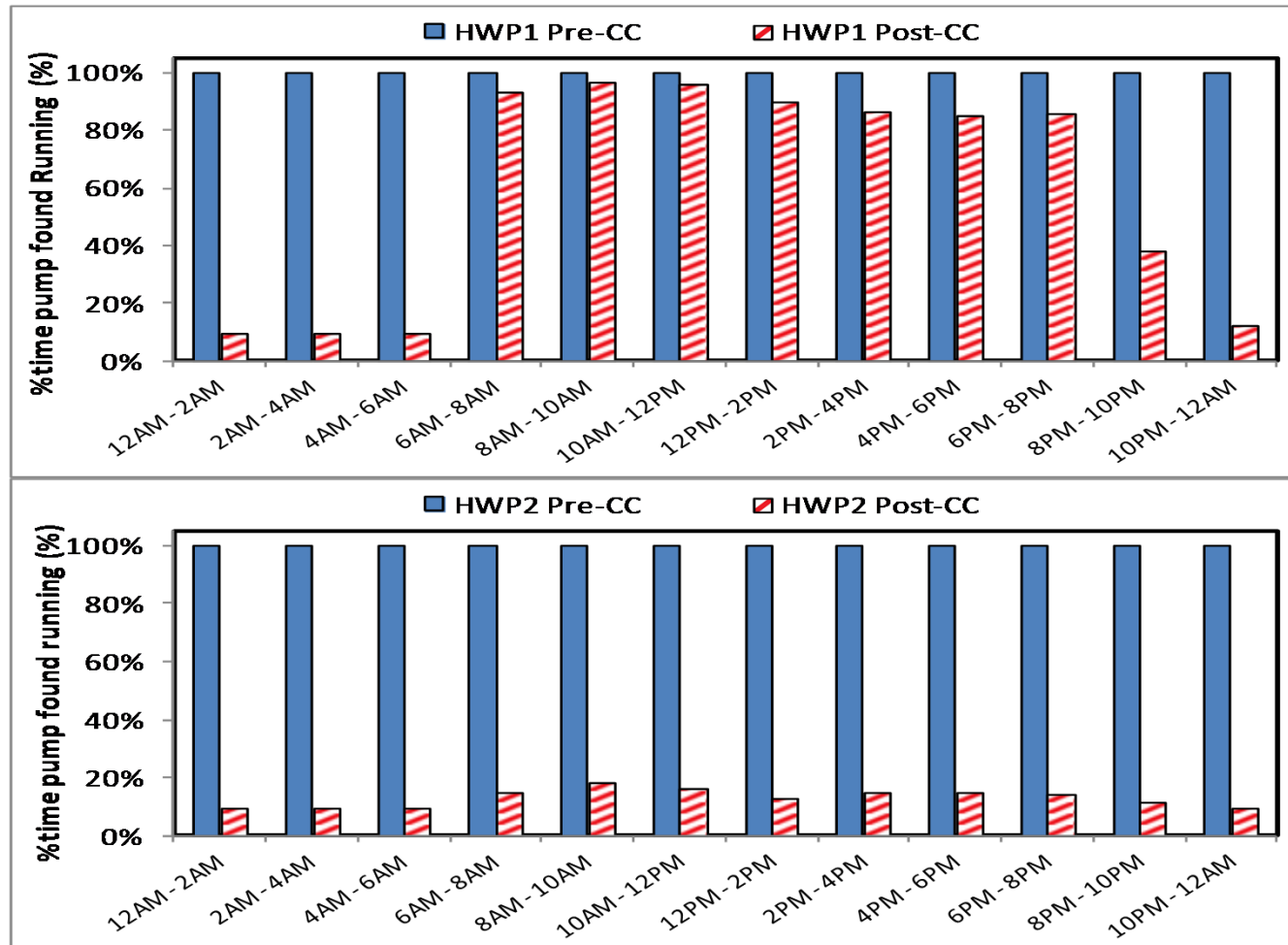


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Examples (cont.)

- Control of Anderson's boilers within the BAS was limited to enable/disable functionality only, and thus fell outside the scope of the project. However, due to trend analysis it was discovered the HW pumps were running around the clock.
- After automatic control was restored, after-hours operation was limited to night setback calls only, and the pumps staged as intended with hot water pump no. 2 (HWP2) rarely coming on.

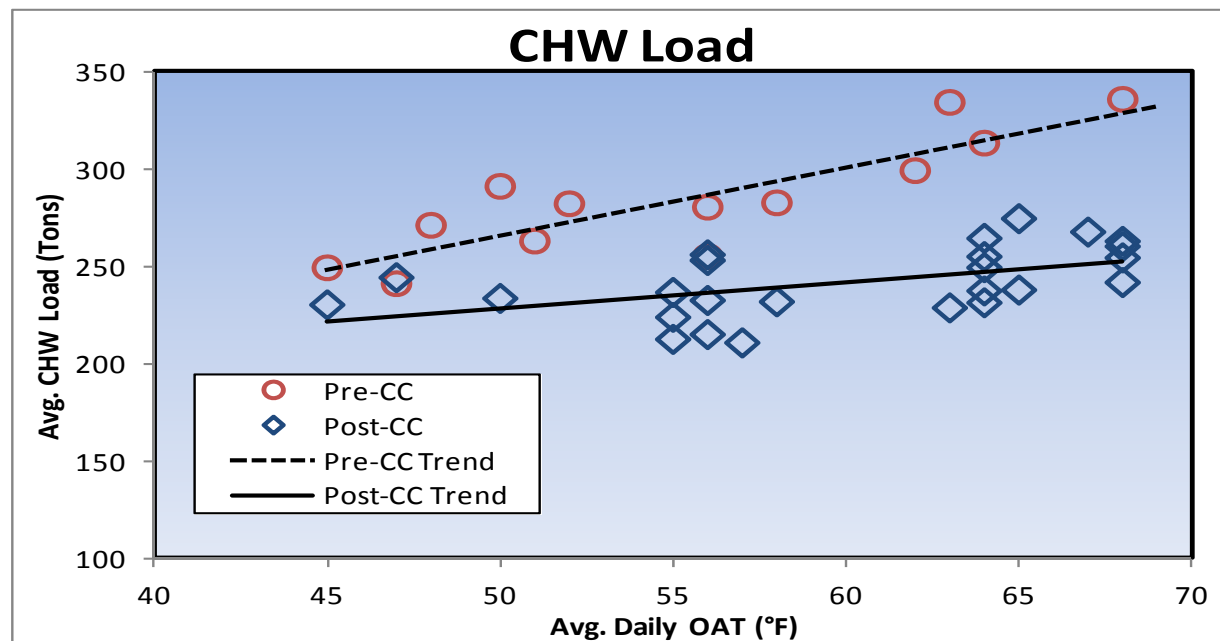
Case Study: Examples (cont.)



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Examples (cont.)

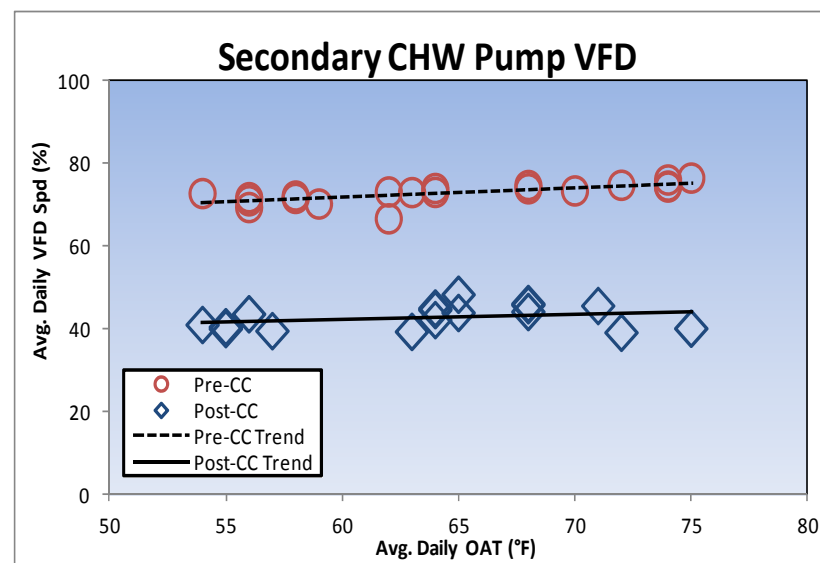
- Cooling supplied to the building was trended in the BAS to monitor the indirect effects of changing setpoints, widening deadbands, reducing reheat, etc. Figure below shows the average daily loads during operation plotted against corresponding average daily outside air temperatures. Sequence changes related to CHW load were successful in reducing the CHW consumption as expected.



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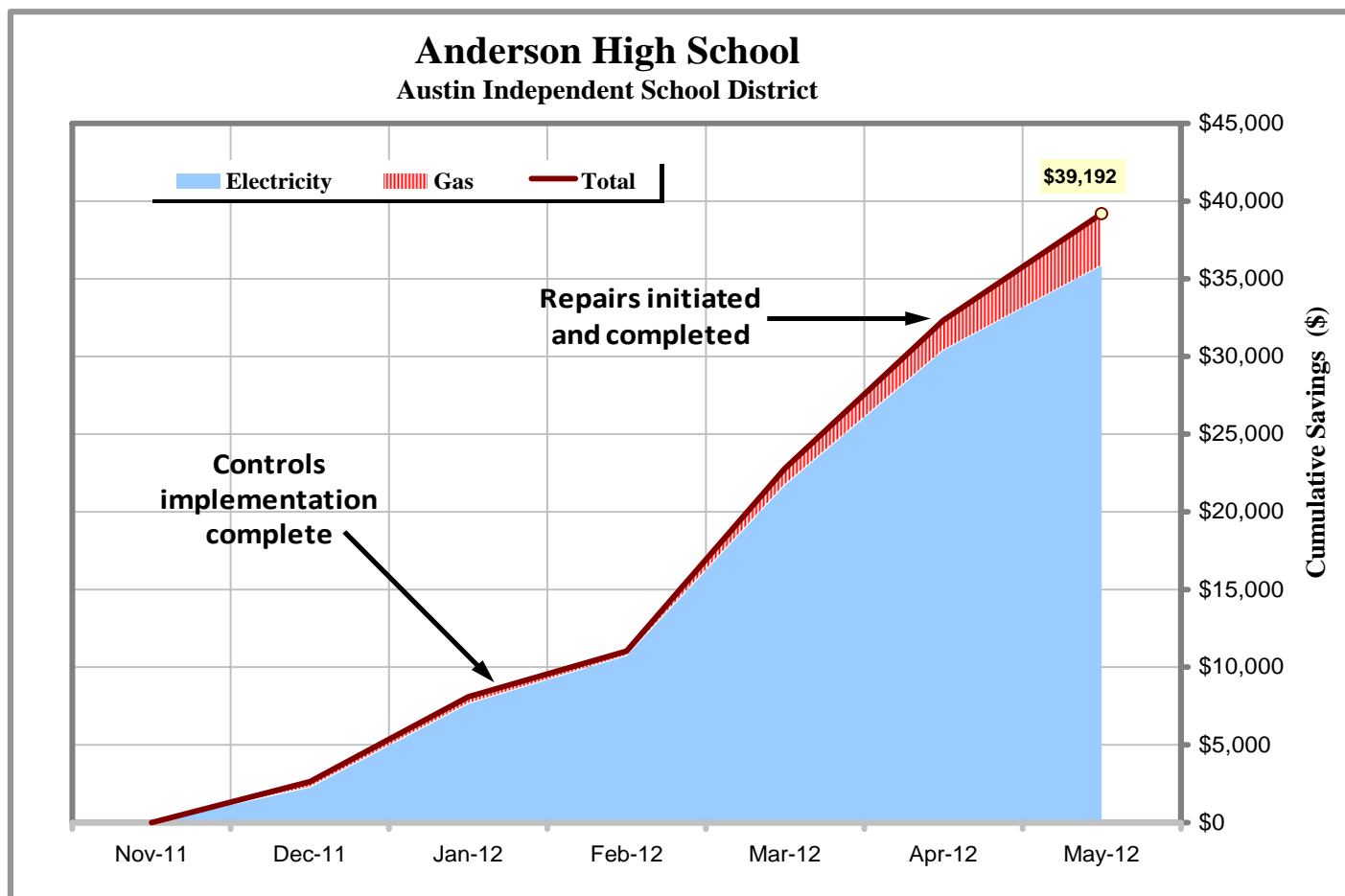
Examples (cont.)

- The DP setpoint for the secondary CHW pump VFDs was reset in order to maintain the most open AHU CHW coil valve at 90%. It was suspected prior to implementation that the existing constant DP setpoint was far higher than necessary under most conditions. Post implementation trend data confirmed this suspicion. Resetting based on actual demand made the system more dynamic and self balancing, allowing the pumps to slow significantly.



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M&V – Savings Report (cont.)



(Courtesy- ESL)

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Lessons

- Team effort
 - Analysis of trend data relevant to individual measures played a vital role
- Using "micro" level data analysis and feedback throughout the CC[®] process, in concert with "macro" level whole building M&V down the line, can be a valuable tool
 - Feedback tool for future assessment studies
- Automated tools such as dashboards are being developed to help monitor and improve the process. However, sound engineering practice and experienced hands-on analysis is essential
- In addition to potentially increasing project savings, micro analysis can also increase building owner and operator confidence in the CC[®] team and process

Discussion and/or Questions?

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